

**Office of National Marine Sanctuaries/National Centers for Coastal
Ocean Science Long-term Agreement (ONMS/NCCOS LTA)**

**2004 Annual Liaison Report on Existing and Potential ONMS/NCCOS
Collaborative Studies at the Monterey Bay National Marine Sanctuary
(MBNMS)**



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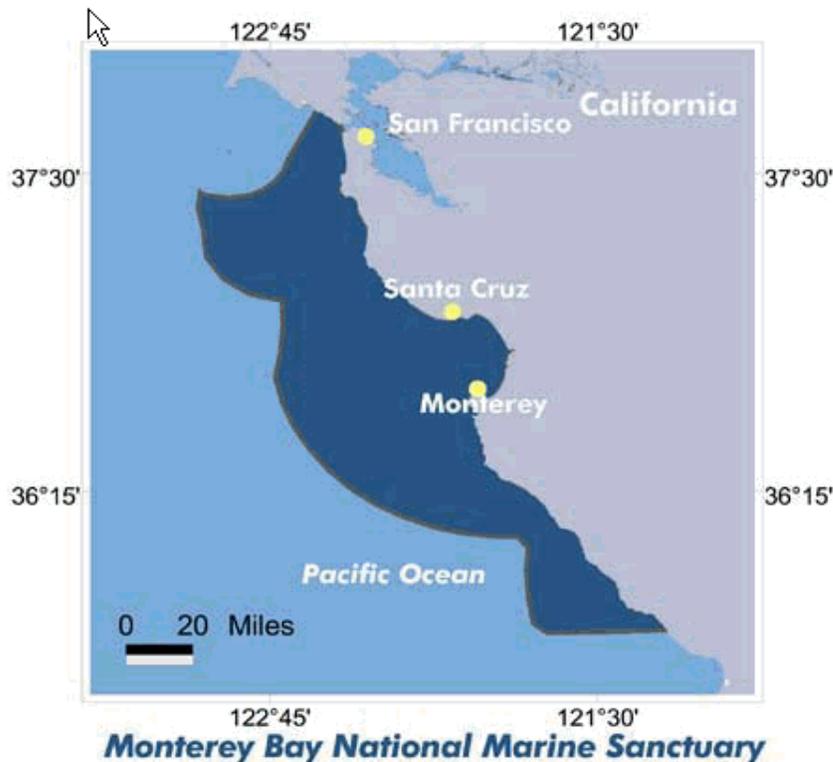
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I. INTRODUCTION

Monterey Bay National Marine Sanctuary is the largest national marine sanctuary encompassing some 13,780 sq km (5,322 sq miles) of ocean area adjacent to the California coast. Its area stretches nearly 650 km (400 miles) north to south and extends on an average 56 km (35 miles) offshore. Visitors will find in the southern half a mostly undeveloped shoreline of sand dunes and steep mountainsides. The northern shoreline is similar but dotted with small towns and moderate-size cities.



The sanctuary is managed to balance recreational and commercial uses with protection of natural resources, water quality, habitats, and its bountiful resident and migratory marine life. The highly productive and biologically rich waters of the sanctuary support a large variety of fauna and flora, including nearly 350 species of fish, 94 species of birds, 33 species of marine mammals, and more than 450 species of marine algae. The sanctuary is also a habitat for 26 species that receive special consideration under the Endangered Species Act.

II. MANAGEMENT PLAN

The sanctuary's management plan focuses on four inter-connected elements: research, resource protection, education and outreach, and program support. A part of the plan is to ensure that human activities in the sanctuary do not adversely affect natural resources, including habitat. This is accomplished through a variety of approaches, such as collaborative planning efforts to prevent and reduce human impacts; regulations, permits and enforcement efforts; and helping to educate the public and sanctuary users about how they can minimize or eliminate harmful activities or behavior. Working closely with the

public and stakeholder groups, sanctuary management has identified a number of resource management issues. These issues relate to coastal development, ecosystem protection, water quality, disturbance of wildlife, and education. Examples of specific management issues include: coastal armoring, desalination, harbors and dredge disposal, impact of buried cables, Davidson Seamount, introduced species, special marine protected areas, beach closures and contamination, cruise ship discharges, water quality program implementation, marine mammal/seabird/turtle disturbance, motorized personal watercraft, tidepool protection, Sanctuary Integrated Monitoring Network (SIMoN), Sanctuary Advisory Council (SAC), fishing-related research and education, interpretive facilities, and multicultural outreach. These issues are addressed in a variety of ways including education, research and promulgation of regulations and prohibitions. Eleven prohibitions have been outlined for the sanctuary, including exploration, development or production activities for oil and gas or minerals resources, drilling into, dredging or otherwise altering the seabed, taking of any marine mammal, sea turtle or seabird in or above the sanctuary, and attracting white sharks, among others. Many of the prohibited activities allow for exceptions (ref. Title 15 CFR 922.132).

III. RESEARCH

In large part due to its unique and spectacular features, such as submarine canyons, and teeming fish and wildlife resources, Monterey Bay and adjoining coastal waters have received considerable scientific attention for over 100 years. The first research facility in the region, Hopkins Marine Station, was founded in 1892. Currently, there are more than a 40 research institutions and laboratories that are engaged in a variety of scientific disciplines that pertain to the sanctuary and its environs. The Monterey Bay Aquarium Research Institute has a long history of research and development of technologies to explore the ocean environment, including excursions by unmanned submersibles into the regions' submarine canyons and other large features. As a consequence, many aspects of the region's environment are well known and in some aspects the MBNMS has a position of leadership in ocean exploration, tools development and resource assessment.

Research planning is a continuous effort both within the sanctuary and as part of the overall, system-wide efforts. Within the sanctuary, research planning efforts are carried out in consultation with a highly capable and supportive research community in the region. The Research Activities Panel (RAP) consists of representatives from twenty research institutions; it offers advice and consultation to the sanctuary management on emerging research issues and formulates collaborative research projects. The sanctuary regularly publishes a synopsis of research accomplishments and future plans, such as an annual report on Ecosystem Observations (MBNMS, 1999).

An outline of the Sanctuary Management Plan, and research activities to address specific management needs in the MBNMS were detailed in 1992 (<http://montereybay.noaa.gov/intro/documents.html>). More recently, a system-wide articulation of a management framework and analysis of research end-points, including adequacy of the current knowledge base, for addressing nine management issues was published (ONMS, 2002). According to the report, over one-half of the "high relevance end-points" in MBNMS may merit substantial increases in science activity. Zoning,

fishing/harvest effects, and wildlife disturbance appeared to be the management issues warranting the greatest need for additional research and analyses.

A report of field observations and sampling by the Sanctuaries Research Team in 2003 provides the objectives and summary of activities of four projects (<http://montereybay.nos.noaa.gov/sac/2003/120503/agenda.html>). These projects addressed a range of management issues in the region, including characterization of habitats and assessment of fish populations, delineation of sites sensitive to road maintenance dumping, determination of oil spill threats, and information for developing a national policy on undersea cable in Sanctuaries.

A significant, related effort to research activities in the bay is the Sanctuary Integrated Monitoring Network (SIMoN). The network allows researchers to monitor the sanctuary's environment and resources by integrating their observations with data from many other research institutions, identifying data gaps, and formulating future research projects. The network also facilitates dissemination of data to resource managers and decision-makers as well as the public at large (<http://www.mbnms-simon.org>).

The Office of National Marine Sanctuaries (ONMS) recently sponsored workshops to identify critical information needs associated with management issues in order to assess the current levels of understanding and plan future research and monitoring activities. The workshop proceedings provide a listing of research activities as well as endpoints (endpoints are described as science objectives to address an information need, such as the spatial and temporal patterns of distribution for selected species) for nine priority issues: habitat delineation, zoning, assessment of living marine resources, water quality protection, fishing/harvest effects, wildlife disturbance, event response, restoration and rehabilitation, and industrial uses (ONMS, 2001). The office also sponsored a workshop to discuss various approaches and developed a framework for a monitoring program in the sanctuaries, including provisions for sentinel or index sites (ONMS, 2002).

IV. ONMS/NCCOS Long-term Agreement (LTA)

The National Centers for Coastal Ocean Science (NCCOS) and the Office of National Marine Sanctuaries (ONMS) signed a Memorandum of Understanding in September 2002 regarding inter-office cooperation and implementation of research activities to support management issues within the sanctuaries. The principal objective for the two parties under the LTA is to effectively manage NOAA's National Marine Sanctuaries using the best available science. NCCOS will work with ONMS to further develop and refine the science-based management program by providing a research perspective, as well as supporting scientific data and information products and recommendations, in the formulation of the management goals and by evaluating the effectiveness of the research activities in fulfilling those goals.

The priorities for the five-year period (FY2003 to FY 2007) under the LTA will focus on: (1) characterization of the sanctuary resources in the context of each sanctuary's management plan; (2) monitoring changes in sanctuary resources, particularly in response to management decisions; (3) conducting anticipatory science; and (4) addressing

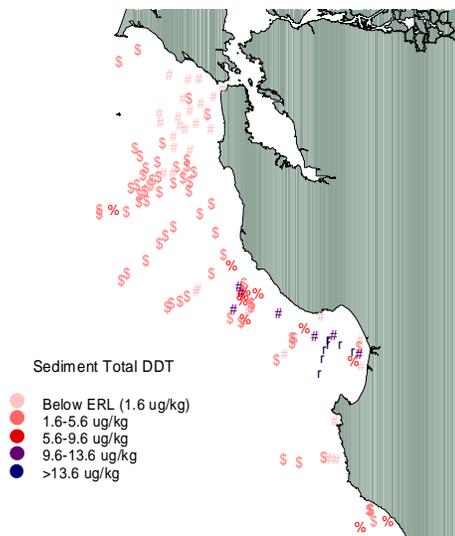
specialized topics that may be identified by ONMS and NCCOS as particularly timely or promising.

This report provides a summary of activities under three collaborative projects that were active during FY 2003. The first-mentioned project was not funded under the ONMS/NCCOS LTA. The project plans predated the LTA and was planned in coordination with ONMS. However, the project is viewed as a NCCOS contribution to further improving the database on the characterization of the environment and resources of the sanctuaries. The principal investigators have been identified for each study and they may be contacted to receive more detailed information about their projects.

V. SUMMARY OF RESEARCH ACTIVITIES UNDER THE AGREEMENT

1. Ambient Environmental Characterization of the Monterey Bay and Gulf of Farallones NMS and Adjacent Ocean Waters (Ian.Hartwell@noaa.gov)

A field sampling cruise on board the NOAA Ship *McArthur* was carried out off the central California coast in spring 2002 in collaboration with scientists from the US Geological Survey. The research objectives included characterization of the regional environment in terms of geomorphology and sediment characteristics, distribution of contaminants, transport pathways and potential accumulation areas for environmentally



persistent contaminants, optical features and phytoplankton pigment distribution, and sea-truth observations for improving existing algorithms for interpretation of satellite imagery. Analyses of these data are underway. A manuscript on the distribution of DDT in sediment in the study area has been published. Preliminary results show that relative to the continental shelf and Pioneer Canyon stations, DDT concentrations in sediment were higher in Ascension and Monterey Canyons. It appears that Monterey Bay still receives DDT from coastal runoff and may be a source of DDT found in Ascension Canyon. DDT concentrations in Monterey Bay biota indicate that the pesticide may also be accumulating in biota at depth

owing to continuing input from shallow waters. The field sampling cruise also provided opportunities for transect sampling (observations) of marine mammals and birds, and diurnal sampling to determine vertical distribution of plankton.

In the spring of 2004, a research cruise was conducted to generate a baseline characterization of the biodiversity of benthic communities in soft bottom habitats in

MBNMS and to identify habitat factors and anthropogenic stressors that influence habitat quality and living resources.

Baseline biogeographical information and habitat delineation are needed to assess the abundance, distribution and interactions of living resources, and allow predictive assessments of natural and anthropogenic processes on the general health of the system as it relates to productivity and more direct living resource management issues. Sediment sampling was conducted to assess biota and contaminant levels in Pioneer, Ascension, Ano Nuevo, Soquel, Monterey and Carmel Canyons. Five transects over the continental shelf and slope were also sampled to contrast habitat conditions in stable areas. Sediments were analyzed for contaminants and physical/chemical characteristics. The data show a distinct gradient of contaminant transport out of Monterey Bay to deep water down the canyon and northward on the shelf to be intercepted by Ascension and Ano Nuevo Canyons. Basic water quality parameters were also measured. The biological community data will be analyzed when sufficient funds are identified. The physical/chemical data will then be used to assess the habitat characteristics that are the determinant factors in the establishment of community associations. This technique was recently developed by CCMA to describe and evaluate benthic community relationships in large coastal systems. A data base file including all taxonomic information on recognized species and any new species encountered will be created in a format compatible with existing data bases and web sites.

2. An Update on Year 2 of a Biogeographic Assessment off North/Central California: Phase 2 - Completion of the Bird and Mammal Assessments

(Mark.Monaco@noaa.gov)

A marine biogeographic assessment off north/central California was conducted from 2001-2003, to support management activities for three national marine sanctuaries – Cordell Bank, Gulf of the Farallones and Monterey Bay. The main objectives of Phase 1 of this assessment was to collect and analyze the best available marine biological and environmental data to identify important biological areas and time periods within a study area encompassing the three sanctuaries. The assessment has two components: a literature-based summary of the marine and estuarine ecosystems off north/central California; and a GIS-based assessment and analyses of selected marine resources and important biological areas and time periods in the study area. Particular emphasis is placed on natural resource protection (e.g., boundary modification), and updating the information available to sanctuary managers on important biological areas (e.g., areas of high diversity, density, or protected species). Products from the Phase 1 Assessment include: an ecological linkages report, an atlas of resources for the area including hundreds of resource analyses and maps, and a website and CD of the products. Visit http://biogeo.nos.noaa.gov/products/canms_cd/ to view Phase 1 assessment products.

Phase 2 is being conducted to complete the mammal assessment and expand the bird assessment to update information for specific colonies and species. Year one activities included awards of: 1) a contract for mapping, analysis, and use of a data set; and 2) an interagency agreement with the Fish and Wildlife Service. Year 1 also included

collection of pinniped and seabird data, reconsideration of analyses, and reformatting the Phase 1 report into two new online reports, one for marine birds and one for marine mammals, due in December 2005. Data collection will soon end and data analysis and mapping has begun. Draft maps and reports will be developed for online review and final reports will be completed in December. Digital reports and GIS data will be made available to the sanctuaries this year.

3. Characterization and Monitoring of Temperature, Chlorophyll and Light Availability Patterns in National Marine Sanctuaries (Richard.Stumpf@noaa.gov)

The project continues to utilize satellite data that is produced by the NCCOS Center for Coastal Monitoring and Assessment, Remote Sensing Team (CCMA-RST) for coastal U.S. waters. Significant patterns in the temperature, chlorophyll and water quality fields and their variability are being characterized, and trends will be determined at various time-scales for each sanctuary studied. An associated objective is to coordinate with sanctuary staff to optimize the information content in products derived from the satellite data and to minimize additional data processing requirements for sanctuary staff.

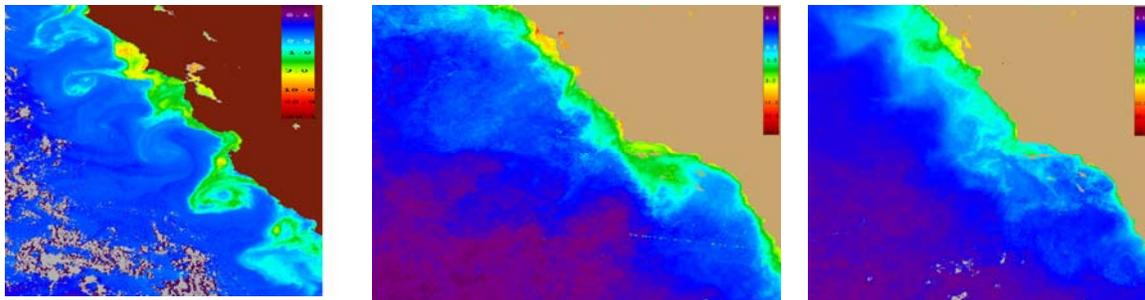
The ocean color data set from NASA's Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) provides a nearly seven year (1997 to present) time series of chlorophyll and light attenuation data. The CCMA-RST has developed algorithms, implemented by NASA for standard processing, to improve the generation of ocean color data and estimation of chlorophyll from SeaWiFS in the coastal zone (Stumpf et al., 2002). The CCMA-RST has reprocessed the entire SeaWiFS data set, applying the improved algorithms and obtaining georeferenced chlorophyll and light availability data at 1-km spatial resolution for all continental U.S. coastal regions. The primary source of sea surface temperature (SST) data is NASA's Pathfinder SST data set, derived from Advanced Very High Resolution Radiometer (AVHRR) data. The Pathfinder data set consists of seventeen years (1985 to 2001) of daily (excepting clouds) and monthly mean, climatological-grade, georeferenced SST data for coastal U.S. waters. Pathfinder was calibrated for inter-comparison of the temperature data across the entire period, facilitating climate and other studies. Spatial resolution of the Pathfinder data varies slightly with latitude, with a horizontal resolution of about 7 km at 35 degrees of latitude. Additional SST data will be obtained to extend the temperature time series through 2004. Data for the waters of the central California Sanctuaries will be extracted from these data sets and analyzed in conjunction with the information on physical forcing conditions.

Discussions with sanctuary research coordinators at a June, 2004 coordination meeting confirmed interest in characterizing upwelling patterns and variability, as well as linking physical patterns and trends seen in chlorophyll, SST and wind fields to biological distributions. Zoning and fishing/harvest effects were identified as priority management issues by all three of the central California sanctuaries, based on a recent evaluation of information needs for the NMS program (Gittings et al. 2002). In addition, water quality issues, particularly non-point source pollution and harmful algal blooms (HABs), were identified as critical management issues by CBNMS and GFNMS. This study specifically addresses water quality issues, and knowledge of spatial and temporal

oceanographic patterns can contribute substantially to understanding fishing/harvest effects. Characterizations of phytoplankton and water quality patterns from satellite data can also easily be incorporated into ongoing biogeographic assessments of Sanctuaries by CCMA, which play a role in zoning.

Preliminary image processing of satellite data for the region that encompasses the central California sanctuaries has been completed, to include generating regional subsets from SeaWiFS ocean color and chlorophyll data, as well as Pathfinder SST data. Both satellite data sets have been reprojected to common geographic bounds and spatial resolution (1 km), in order to facilitate cross-correlations between the datasets and extraction of consistent time series information. Processing of monthly, 5 day, and 8 day Pathfinder SST data has been completed for data from 1985-2001. We are still waiting for more recent SST data to become available. Time series data has been extracted from the available SST data for all three sanctuaries (Gulf of the Farallones, Cordell Bank, and Monterey Bay). Chlorophyll and turbidity imagery (SeaWiFS) are continuously being processed as they are received. Characterization of the sanctuaries physically has begun with the application of remote sensing techniques trying to identify patterns in the data.

A presentation on project data and methods, as well as potential satellite data-derived products was provided at the GFNMS offices on 2 June 2004. The following set of graphics provides chlorophyll features in the region. The leftmost image provides an example of chlorophyll features along the central California coast (San Francisco Bay in center of coast) from a daily SeaWiFS image (17 May 1998). The two images on the right illustrate variability in 60-day mean chlorophyll distributions along the entire California coast, for Apr-May 1998 (center) and Aug-Sep 1998 (rightmost). Higher chlorophyll values are indicated by yellow and red (highest) colors and lower values are represented by blue colors.



VI. PRINCIPAL CONTACTS

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